

CLAIMS

What is claimed is:

1. A method for producing a metallic article comprising a metallic base metal, comprising the steps of
furnishing a nonmetallic precursor compound comprising the metallic base metal selected from the group consisting of nickel, cobalt, iron, iron-nickel, and iron-nickel-cobalt, and mixtures thereof;
chemically reducing the nonmetallic precursor compound to produce an initial metallic particle, without melting the initial metallic particle; and
melting and solidifying the initial metallic particle to produce the metallic article.
2. The method of claim 1, wherein the step of furnishing the nonmetallic precursor compound comprises the steps of
furnishing the nonmetallic precursor compounds comprising the metallic base metal and at least one other metallic element.
3. The method of claim 1, wherein the step of melting and solidifying produces an alloy that is a nickel-base, a cobalt-base, an iron-base, a iron-nickel-base, or a iron-nickel-cobalt-base alloy.
4. The method of claim 1, wherein the step of melting and solidifying produces an alloy having a martensitic steel composition.
5. The method of claim 1, including an additional step, performed prior to the completion of the step of melting and solidifying, of
producing a mixture of a metallic material and an other additive constituent.
6. The method of claim 1, wherein the step of furnishing the nonmetallic

precursor compound comprises the step of

furnishing a mixture of at least two different nonmetallic precursor compounds.

7. The method of claim 1, wherein the step of chemically reducing includes the step of

chemically reducing the compound mixture by solid-phase reduction.

8. The method of claim 1, wherein the step of chemically reducing includes the step of

chemically reducing the compound mixture by fused salt electrolysis.

9. The method of claim 1, wherein the step of chemically reducing includes the step of

chemically reducing the compound mixture by vapor-phase reduction.

10. The method of claim 1, wherein the step of chemically reducing includes the step of

chemically reducing the nonmetallic precursor compound by contact with a liquid selected from the group consisting of a liquid alkali metal and a liquid alkaline earth metal.

11. The method of claim 1, wherein the step of chemically reducing includes the step of

mixing a nonmetallic modifying element into the nonmetallic precursor compound, wherein the nonmetallic modifying element is selected from the group consisting of nitrogen and carbon.

12. The method of claim 1, wherein the step of chemically reducing includes the step of

chemically reducing the nonmetallic precursor compound in a time of less than about 10 seconds.

13. The method of claim 1, wherein the step of melting and solidifying includes the step of
melting and solidifying the initial metallic particle to produce the metallic article, without any addition of a metallic alloying element to the initial metallic particle.

14. The method of claim 1, wherein the step of melting and solidifying includes the step of
adding a metallic alloying element to the initial metallic particle while the initial metallic particle is melted.

15. The method of claim 1, wherein the step of melting and solidifying includes the step of
solidifying the metallic article as a cast article.

16. The method of claim 1, wherein the step of melting and solidifying includes the step of
melting and solidifying the initial metallic particle without contacting a ceramic material.

17. The method of claim 1, wherein the step of melting and solidifying includes the step of
adding an alloying element.

18. The method of claim 15, wherein the cast article is a cast ingot, and wherein the method includes an additional step, after the step of melting and solidifying, of
converting the cast ingot into a billet.

19. The method of claim 1, including an additional step, after the step of melting and solidifying, of

mechanically working the metallic article.

20. The method of claim 1, including an additional step, after the step of melting and solidifying, of
post processing the metallic article.

21. The method of claim 1, including an additional step, after the step of melting and solidifying, of
heat treating the metallic article.

22. The method of claim 1, wherein the metallic article is a superalloy composition, and wherein the method includes an additional step, after the step of melting and solidifying, of
solution heat treating and ageing the metallic article.

23. The method of claim 1, wherein the metallic article is a martensitic steel composition, and wherein the method includes an additional step, after the step of melting and solidifying, of
heat treating the metallic article to form a martensitic microstructure.

24. A method for producing a metallic article comprising as constituents a metallic base metal selected from the group consisting of nickel, cobalt, iron, iron-nickel, and iron-nickel-cobalt, and at least one alloying metal, comprising the steps of

furnishing a mixture of at least two nonmetallic precursor compounds together comprising the constituents of the metallic article, wherein the constituents comprise the metallic base metal selected from the group consisting of nickel, cobalt, iron, iron-nickel, and iron-nickel-cobalt, and at least one alloying metal;

chemically reducing the mixture of nonmetallic precursor compounds to produce an initial metallic particle, without melting the initial metallic particle;

melting and solidifying the initial metallic particle to produce a cast ingot; and

converting the cast ingot into a billet.

25. The method of claim 24, wherein the step of chemically reducing includes the step of

chemically reducing the mixture by contact with a liquid selected from the group consisting of a liquid alkali metal and a liquid alkaline earth metal.

26. The method of claim 24, wherein the step of melting and solidifying produces an alloy that is a nickel-base, a cobalt-base, an iron-base, a iron-nickel-base, or a iron-nickel-cobalt-base alloy.